

small, unless the contraction be very great in proportion to the diameter of the pipe.

A Letter on the Alterations that have taken place in the Structure of Rocks, on the Surface of the basaltic Country in the Counties of Derry and Antrim. Addressed to Humphry Davy, Esq. Sec. R.S. By William Richardson, D.D. Read March 17, 1808. [Phil. Trans. 1808, p. 187.]

The general design of this paper is to show the great distance to which the same strata may be found to extend, or to have extended, over the surface of a country, and thereby to explain the existence of small detached portions of the same species of matter at considerable distances from each other, as having been originally connected by continuity of the same material over the whole surface of the country, whatever be the present interval, and whatever be the quantity of matter which such an hypothesis supposes to have been removed.

The basaltic area which comprehends most part of the county of Antrim and a portion of Derry, appears to Dr. Richardson peculiarly favourable to such speculations, uncommonly regular in its stratification, and highly favoured by nature in the frequent exposure of the strata in their abrupt and precipitous terminations.

In the island of Rathlin, more especially, the original features are most happily displayed, and are still in good preservation.

It is in the periphery at the northern side that the sections are seen to the greatest advantage, as the perpendicular façades are often continued for miles together.

Of these façades, four are more distinguished for their grandeur and beauty than the rest,—Magilligan, Cave Hill, Fairhead, and Bengore. The two former are the extreme points of the N.W. and S.E. diagonal, and are forty miles asunder; at the summits of mountains, accessible by land. The two latter are visible only from the sea, but are more diversified and more curious in their structure.

The promontory of Bengore, which is nearest to the place of Dr. Richardson's residence, has principally engaged his attention; and the minute description of its strata forms a considerable portion of his memoir, for the purpose of showing the station which the Giant's Causeway occupies in the arrangement of the promontory, and also for the purpose of noticing several facts, which he thinks likely to throw light upon the operations performed on our globe since the period of its consolidation.

In the order of the description, Dr. Richardson first gives a general sketch of the promontory when approached from the west, with an account of the inclination, ascent, culmination, and dip of its strata. Of these he enumerates as many as sixteen, and observes that these are all cut perpendicularly in eleven different places by those mighty walls called in Scotland whyn dykes.

These all reach from the top of the precipice to the water, out of

which some of them again emerge in considerable masses, at a distance from the precipice. The dykes are all constructed of horizontal prisms, which form a strong contrast with the vertical pillars of the strata they intersect; and yet, says Dr. Richardson, it is but lately that these singular productions have been noticed; and he states that he himself was the first who observed them, and gave an account which was published in the Transactions of the Royal Irish Academy.

For the purpose of giving a more accurate idea of these dykes, Dr. Richardson gives two views of one of them, which he had overlooked at the time that his essay upon that subject was published.

Of the strata which form the façade of the precipice, the first is sixty feet in thickness, and consists of large basaltic pillars very rudely formed, but generally extending from one surface of the stratum to the other.

The second consists of a substance red as brick, and about nine feet in thickness.

The third is above fifty feet thick, and consists of that variety of basalt termed irregular prismatic, resembling in its grain the columnar basalt, but differing in its construction; as its prisms are small, not articulated, unequal and irregular in the vertical or inclined position of their axes.

The fourth is about seven feet thick, columnar but not regular, generally appearing white from a covering of *Byssus saxatilis*, which has a singular predilection for this stratum.

The fifth is ochreous, but less red than other strata of similar consistence; this is very friable, and is generally covered by a coating of grass.

The sixth is composed of rude massy pillars, very coarsely formed, ten feet long. The transition from these to the seventh Dr. Richardson compared to a hand held downwards, and dividing into separate fingers; since the rude columns of the sixth appear continued into those of the seventh, without any distinct line of separation, but are there found divided into neat slender pillars fifty-four feet in length.

The eighth stratum is also fifty-four feet in thickness, and consists of an irregular prismatic basalt similar to the third.

The ninth is that stratum which has attracted principal attention from the beautiful assemblage of neat pillars of which it consists, and which at the intersection of this stratum have been so long distinguished by the name of the Giant's Causeway. This stratum is forty-four feet in thickness; it first appears at its opposite extremity in Portmoor Bay; from hence it rises and culminates between Bengeore and Pleskin, with its lower edge 200 feet above the water: in its descent at Noffer it composes the group of pillars called the Organ; at all points wherever it is accessible it has the same grain, with the same size and neatness of its prisms.

The tenth stratum on which these pillars rest, is red as minium, and makes a conspicuous figure from the brightness of its colour.

The six remaining strata are all similar to each other, consisting of tabular basalt, but differing in thickness; and being separated only by thin ochreous layers, the division is not always discernible.

From a revision of the various circumstances observable in these strata, Dr. Richardson selects certain facts which he considers of importance to geology. First, that every stratum preserves the same thickness throughout its whole extent. Secondly, that this uniformity of thickness is interrupted only where the upper surface has been exposed by removal of the superior strata. Thirdly, that the curvature of the summits of the façades does not correspond in form to the surfaces of the strata underneath. Fourthly, that the same arrangement does not continue for more than two or three miles. Fifthly, that wherever materials of different species are in contact, the line of demarcation is always distinct and well defined. Sixthly, that the upper part of any façades, where the strata are exposed, is generally perpendicular, and the lower steep and precipitous. Seventhly, that the rude masses which appear in the sea at the base of the precipices, are not, as has been supposed, ruins which have fallen from the strata above, but are remnants of lower strata remaining in their original position. Eighthly, that these abrupt sections are by no means confined to the coast, but are often formed on the ridges of the hills, at a distance from the sea. Ninthly, that in all such abrupt terminations of strata, whether on the coast or within land, the materials broken off are completely carried away, without a fragment being left behind.

The formation of these abrupt precipices has been, by some, ascribed to the action of the sea: but it is only by careless observers, in Dr. Richardson's estimation, that such an hypothesis can be admitted; since even here the base of that part, which is perpendicular, is elevated 200 or 300 feet above the level of the sea; and the bases of others are no less than at 1400 feet elevation, and at the distance of four miles from the sea at Magilligan, of thirteen at Bienbraddock, and seventeen miles at Monyneeny.

The exact resemblance between the inland façades and those on the shore, proves them all to have been cut down perpendicularly by the same agent, which has not confined its operations to the coast, or to the periphery of the basaltic area. We can trace it, says the author, over its whole surface.

Some persons have maintained that the inequalities are those of original conformation; as if the world had come from the hands of the Creator with all the varieties which now contribute so much to its beauty.

Others, admitting the original continuity of the strata, and their subsequent abruption, have differed concerning the direction in which the cause has acted; some preferring the milder and more gradual operation of waters from above the surface, which, according to Dr. Richardson, rather tend to level than to raise inequalities; while others conceive the highest mountains to have been blown up from the bottom of the sea by furious explosions, which, in the author's

estimation, can never have taken place beneath the present rectilinear and parallel strata.

Dr. Richardson assumes as a fact, that strata having very strong resemblance were once continuous, however interrupted we now find them; for instance, the stratified remnants at the tops of the Seafin and Slievegallon, between which the valley of the Mayola is an excavation 1700 feet deep and three miles wide, were originally connected in their present position by similar materials, the whole of which have been completely carried away. And again, to the northward, between Seafin and Carntogher, the same stupendous operations have carried away the parts which formerly connected these undisturbed remains of the same strata.

The number of basaltic hummocks thus left on the tops of various mountains, is represented to be considerable, as if they had been left by the unknown sculptor for the express purpose of showing how high the original surface of the country formerly reached,—a conclusion which appears formidable; but the author does not admit that anything is absurd, incredible, or impossible, in geology and cosmogony.

A Letter on the Differences in the Structure of Calculi, which arise from their being formed in different Parts of the Urinary Passages; and on the Effects that are produced upon them, by the internal Use of solvent Medicines, from Mr. William Brande to Everard Home, Esq. F.R.S. Read May 19, 1808. [Phil. Trans. 1808, p. 223.]

Mr. Brande's observations were made during an examination of the calculi contained in the Hunterian Museum, and of some also in the possession of Mr. Home.

Three calculi, formed in the kidneys, were examined. One consisted of uric acid, nearly pure; another, weighing seven grains, contained $4\frac{1}{2}$ uric acid, and $2\frac{1}{2}$ animal matter. A third consisted of oxalate of lime; and it is added that a fine powder is also voided from the kidneys, consisting of the ammoniacal phosphate of magnesia, and of phosphate of lime.

Calculi retained in the infundibula, or pelvis of the kidneys, may be increased either by a deposition of uric acid, or may be coated by an external lamina, consisting of the phosphates.

Calculi met with in the bladder, are of four kinds.

1. Formed on nuclei of uric acid, from the kidneys.
2. On nuclei of oxalate of lime, from the kidneys.
3. Formed on sand or mucus deposited in the bladder.
4. Formed on extraneous bodies introduced into the bladder.

Those consisting of uric acid vary in colour, from a deep reddish brown to a pale yellowish brown. Those containing phosphate of lime, and the triple phosphate of magnesia, are whiter, and are often soft and friable. Those which contain oxalate of lime, called mulberry calculi, are browner, harder, and less soluble.

Out of 150 examined by Mr. Brande,

16 were composed of uric acid.